IN THE SPECIFICATION:

Please amend the title of the invention as follows:

~~ELECTROMAGNETIC LENS ARRAY ANTENNA DEVICE~~ RADIO WAVE LENS ANTENNA

Please insert the following paragraph on page 1 below the title of the Invention and above the "Field of the Invention":

-- Related Application

This application is the U.S. National Phase under 35 U.S.C. § 371 of International Application No. PCT/JP2004/007613, filed on June 2, 2004, which in turn claims the benefit of Japanese Application No. 2003-161128, filed on June 5, 2003, and Japanese Application No. 2004-156002, filed on May 26, 2004, the disclosures of which Applications are incorporated by reference herein. –

Please amend the paragraph beginning at page 5, line 11 as follows:

Figs. ~~2(a), (b)~~ 2A and 2B show the comparative antenna patterns in cases of a uniform amplitude distribution and a tapered amplitude distribution. As shown Fig. [[2(a)]] 2A, if the amplitude distribution is uniform, the levels of the sidelobes S compared to that of the main lobe M become relatively high, whereas the sidelobes S are decreased if the amplitude distribution is tapered as shown in Fig. [[2(b)]] 2B.

Please amend the paragraph beginning at page 6, line 7 as follows:

Meanwhile, [[since]] a focal length of conventional parabolic antenna is greater than that of the lens antenna~~, the physical interval between primary feeds required to independently communicate with adjacent satellites can be large~~. Therefore, the primary feed can be designed without restriction on that account and a circular horn antenna (conical horn antenna whose opening size is over 30 mm) is generally used. However, the parabolic antenna cannot communicate with a plurality of satellites. Further, there is a problem that the parabolic antenna is bulky, because parts

such as a supporting arm or the like of the primary feed become bigger to accommodate the longer focal length.

Please insert the following before the "Detailed Description of the Preferred Embodiment" on page 11, at line 11:

--Brief Description of the Drawings

Fig. 1 offers a schematic diagram of an antenna using a hemispherical Luneberg radio wave lens.

Fig. 2A shows an antenna pattern in case of a uniform amplitude distribution and Fig. 2B is an antenna pattern in case of a tapered amplitude distribution.

Fig. 3A provides a perspective view for describing main parts of an exemplary primary feed and Fig. 3B illustrates a cross section of a rectangular waveguide.

Fig. 4 sets forth a perspective view for describing main parts of another exemplary primary feed.

Fig. 5 shows a side view for describing main parts of the basic configuration of the primary feed.

Fig. 6 provides a side view of the main parts of the primary feed further having a choke structure.

Fig. 7 describes a cross sectional view of the main parts of the primary feed loaded with a convex lens-shaped dielectric body.

Fig. 8A depicts the disposition of two primary feeds employing circular waveguides and Fig. 8B is the disposition of two primary feeds employing rectangular waveguides.

Figs. 9A to 9F describe specific examples for the cross sectional shape of the protrusion of the dielectric body.

Figs. 10A to 10D provide specific examples for the side shape of the protrusion of the dielectric body.

Fig. 11 shows an example of suppressing the coupling by using primary feeds loaded with dielectric bodies of a shape having a non-rotational symmetric end.

Figs. 12A and 12B show an example for suppressing the coupling by cutting out a part of the dielectric body protruded from the waveguide.

Fig. 13 presents antenna patterns for comparing weak coupling with strong coupling.

Fig. 14 shows an antenna pattern of an antenna with wide full width at half maximum.

Fig. 15 describes an antenna pattern of an antenna in case of using a dielectric-loaded waveguide antenna as a primary feed.--

Please amend the paragraph beginning at page 11, line 14 as follows:

Figs. 3A to 13 represent preferred embodiments of the present invention. The basic structure of a radio wave lens antenna in accordance with the present invention is identical to that shown in Fig. 1 (there can be the one that employs a spherical Luneberg radio wave lens without a reflective plate) except a primary feed and a method for disposing two primary feeds closely. Thus, only the structures or the disposition methods of the primary feeds are described in the embodiments.

Please amend the paragraph beginning at page 11, line 22 as follows:

A primary feed 3 in Fig. 3A is constructed by loading a dielectric body 6 having a polygonal column shape at the end opening of a rectangular waveguide 4.

Please amend the paragraph beginning at page 12, line 9 as follows:

The material of the waveguides 4 and 5 can be a metal such as brass or aluminum or a die-casting with a high production yield. For the size of the waveguides 4 and 5, each side can be not greater than 18 mm (both a and b in Fig. [[3(a)]] 3A are not greater than 18 mm) in case of a rectangular waveguide for 12 GHz frequency band, for example. Therefore, even though the interval between primary feeds is 19.2 mm as described above, the primary feeds can be arranged at desired positions without interfering each other.

Please amend the paragraph beginning at page 13, line 11 as follows:

Figs. 8A to 13 provide useful primary feeds when intervals between elements are small and there is a potential coupling problem.

Please amend the paragraph beginning at page 13, line 14 as follows:

In Figs. ~~8(a), (b)~~ 8A and 8B, there are respectively shown two primary feeds 3 using circular waveguides 5 and using rectangular waveguides 4 which are arranged at the interval of P corresponding to the distance between geostationary satellites. The rectangular waveguide is advantageous in that it has a smaller tube size than the circular waveguide when adapted to a radio wave of a same frequency. Therefore, in case two primary feeds 3 are arranged at the interval of P by using the rectangular waveguides 4, the interval P1 between dielectric bodies 6 of both primary feeds is larger than the case by using the circular waveguides 5 and, thus, the coupling becomes weaker.

Please amend the paragraph beginning at page 13, line 26 and bridging page 14 as follows:

Each primary feed is arranged toward the center of the radio wave lens and thus the interval between the adjacent primary feeds becomes narrower when approaching closer to the ends of the elements. Therefore, it is preferable that the dielectric body 6 protruded from the waveguide is of a taper shape having a thinned end. [[Fig. 9]] Figs. 9A to 9F illustrate[[s]] exemplary cross sectional views of the protrusions. In all the exemplified protrusions, the width w (minor axis of an ellipse) is smaller than the dimension d in the direction normal to the width (major axis of an ellipse). Thus, by setting the direction of the dielectric body 6 in such a manner that the width direction coincides with the arranged direction of the primary feeds, a distance between the dielectric bodies of the adjacent primary feeds can be made larger.

Please amend the paragraph beginning at page 14, line 15 as follows:

[[Fig. 10]] Figs. 10A to 10D show[[s]] examples in which each of the protrusions of the dielectric bodies 6 from the waveguides has a taper shape having a thinned end. In Fig. [[10(a)]] 10A, the dielectric body 6 protruded from the waveguide is of an elliptical or polygonal cone shape while the apex of the cone is located at the center axis of the base of the cone. By cutting out the end of the protrusion as shown in Fig. ~~10(b) or 10(c)~~ 10B or 10C, the dimension of the primary feed along the axial direction is reduced. Thus, since the distance from the surface of the radio wave lens to the focal point becomes small, the size of the antenna can be further scaled down.

Please amend the paragraph beginning at page 15, line 1 as follows:

Further, considering water repellence in case of being wetted by rain, it is preferable that the cut-out end of the dielectric body 6 is of a round shape as shown in Fig. [[10(c)]] 10C rather than flat as shown in Fig. [[10(b)]] 10B.

Please amend the paragraph beginning at page 15, line 5 as follows:

When the protrusion of the dielectric body 6 is of a cone-shape, the vertex is located off the center axis of the base of the cone as illustrated Fig. [[10(d)]] 10D. In the present invention, two primary feeds 3 each having the dielectric body 6 whose protrusion is of a non-rotational symmetrical shape as described above are disposed closely. If two primary feeds are disposed closely, mutual coupling phenomena occurs, resulting in the distortion of radio waves captured by the respective primary feeds. However, the distortion can be reduced by disposing the ends of the protrusions of the dielectric bodies 6 at off-centered positions in such manner that they are remotely spaced apart from each other as shown in Fig. 11.

Please amend the paragraph beginning at page 15, line 19and bridging page 20 as follows:

As illustrated in [[Fig. 12]] Figs. 12A and 12B, a part of the outer periphery of the protrusion of the dielectric body 6 is cut out along the plane of a direction intersecting the cross section normal to the axis of the waveguide and such dielectric bodies 6 are loaded to the waveguides of the adjacent primary feeds in such a manner that the cut out surfaces of the outer peripheries face each other. The coupling can be also reduced in such a structure. Although the cut out surface of the outer periphery of the dielectric body 6 is shown to be perpendicular to the

cross section normal to the axis, it need not be.

Please amend the paragraph beginning at page 16, line 18 and bridging page 17 as follows:

All of the above described primary feeds satisfy the following basic properties 1)-4) which are required in the element for the radio wave lens antenna of Fig. 1. Consequently, the requirement of the low sidelobe can be satisfied, which makes independent communications with adjacent satellites possible and which is a collective characteristic with a Luneberg radio wave lens:

1) The size is equal to or less than 0.8λ (λ: wavelength, for example, about 25 mm in case of 12.5 GHz frequency);

2) For example, the full width at half maximum of about 50 degrees can be realized;

3) It is a linearly polarized wave antenna for common use for both vertical (V) and horizontal (H) linearly polarized waves (if this condition is satisfied, it can be applied to the circularly polarized wave antenna); and

4) The antenna patterns of the E-plane and H-plane (see Fig. [[3(b)]] 3B) can be identical as much as possible.

Please delete the paragraphs beginning on page 18, at line 1 and ending on page 20, at line 4 as follows:

~~Brief Description of the Drawings~~

~~Fig. 1 offers a schematic diagram of an antenna using a hemispherical Luneberg radio wave lens.~~

~~Fig. 2(a) shows an antenna pattern in case of a uniform amplitude distribution and Fig. 2(b) is an antenna pattern in case of a tapered amplitude distribution.~~

~~Fig. 3(a) provides a perspective view for describing main parts of an exemplary primary feed and Fig. 3(b) illustrates a cross section of a rectangular waveguide.~~

~~Fig. 4 sets forth a perspective view for describing main parts of another exemplary primary feed.~~

~~Fig. 5 shows a side view for describing main parts of the basic configuration of the primary feed.~~

~~Fig. 6 provides a side view of the main parts of the primary feed further having a choke structure.~~

~~Fig. 7 describes a cross sectional view of the main parts of the primary feed loaded with a convex lens-shaped dielectric body.~~

~~Fig. 8(a) depicts the disposition of two primary feeds employing circular waveguides and Fig. 8(b) is the disposition of two primary feeds employing rectangular waveguides.~~

~~Figs. 9(a) to 9(f) describe specific examples for the cross sectional shape of the protrusion of the dielectric body.~~

~~Figs. 10(a) to 10(d) provide specific examples for the side shape of the protrusion of the dielectric body.~~

~~Fig. 11 shows an example of suppressing the coupling by using primary feeds loaded with dielectric bodies of a shape having a non-rotational symmetric end.~~

~~Fig. 12 shows an example for suppressing the coupling by cutting out a part of the dielectric body protruded from the waveguide.~~

~~Fig. 13 presents antenna patterns for comparing weak coupling with strong coupling.~~

~~Fig. 14 shows an antenna pattern of an antenna with wide full width at half maximum.~~

~~Fig. 15 describes an antenna pattern of an antenna in case of using a dielectric-loaded waveguide antenna as a primary feed.~~

~~[Description of the Reference numeral]~~

~~1 ———— Luneberg radio wave lens~~

~~2 ———— Reflective plate~~

~~3 ———— Primary feed~~

~~4 ———— Rectangular waveguide~~

~~5 ———— Circular waveguide~~

~~6 ———— Dielectric body~~

~~7 ———— Groove~~

~~A radio wave~~

~~M Main lobe~~

~~S Sidelobe~~